

XVI. THE MAMMALIAN FAUNA OF PENNSYLVANIA.

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(PLATE XIV)

The first attempt to make a systematic survey of the mammalian fauna of Pennsylvania was made by Samuel N. Rhoads, Esq., of Philadelphia, who in 1903 privately published the results of his investigations under the title "The Mammals of Pennsylvania and New Jersey." Rhoads did his work thoroughly and capably and his paper still stands as the basis of our knowledge of the geographical distribution of species within the confines of the state of Pennsylvania.¹

In 1897 there was published by the State of Pennsylvania a document by Dr. B. H. Warren entitled, "Diseases and Enemies of Poultry," which included accounts of various predaceous mammals known to exist in the state. Although many interesting notes concerning the occurrence of various species were included, there was no attempt to establish the distributional ranges of the various species mentioned.

Several local lists have been made and included in County Histories and other local publications. Among the most reliable of these was "A List of The Mammals of Beaver County" by W. E. C. Todd in Bausman's "History of Beaver County, Pennsylvania," published in 1904.

In its primeval state Pennsylvania was rich in animal life. Many of the forms, which roamed "Penn's Woods," have there become extinct. Among these are the Bison, the Cougar, or Mountain-Lion, and the Wolf. Other forms have been so reduced in numbers that without protective measures their extermination is inevitable.

There is no doubt that the mammals of the world have reached the peak of their development as far as size is concerned. Those animals, which persist, will, in all probability, be reduced in size. The spread of so-called civilization will result in the extermination of the larger

¹At the present time the Pennsylvania Game Commission is recording localities of all animals on which bounties are paid. Within a few years these records should serve as an excellent source of information as to the general distribution of such species. The numbers of each species on which bounties are paid will serve to indicate the relative abundance of the various predatory mammals.

mammals and the time is not far distant when they will be "of the past." In all probability, future generations will look with awe upon the towering forms of giraffes, elephants, and even smaller forms, such as the horse, solely preserved in the galleries of our museums.

Within a few decades we have witnessed a great reduction in number of the wild animals on our American plains and in the interior of Africa and South America. Fear is being expressed for the possibility of the extermination of the Gorilla. The whaling industry, the sealing industry, and the fur-business in general, have been greatly reduced in their proportions. While the demand for furs is still great, the supply is rapidly becoming limited. It even may be doubted whether in this age of mechanical advance breeding will sustain the numbers of some of the larger mammals. Horse-racing, as a sport, may succumb, before the ever increasing mania for speed. The horse is being replaced by automobiles and aeroplanes. From the standpoint of experimental genetics we have no reason to believe that the larger animals will continue as subjects for study, because of their long periods of gestation and because of the impracticability of maintaining them. The tendency is to use minute forms, such as fruit-flies and parasitic wasps, numerous generations of which may be secured in a short space of time, and kept for observation.

The extermination of larger animals will, naturally disturb the balance of nature, and it may require the passing of many years before conditions eventually become stabilized. When equilibrium is again restored and new interdependencies have been established, the resulting fauna will be reduced in the number of species, and in size. Arboreal forms will be few. There will be a paucity of large cursorial forms; the smaller subterranean animals, being the more secure, will be the most abundant.

The faunal history of Pennsylvania has already demonstrated such tendencies. Not many years ago such animals as the deer and the bear were so scarce, so that, when an individual of either species was seen, it was of sufficient interest to call for mention in the newspapers. The increase of these animals in the past few years is due entirely to restocking, the acquisition of lands by the state, and the rigid enforcement of protective measures put into effect at the suggestion of the State Game Commission.

While the larger animals were being decimated in years gone by, little attention was paid to a multitude of smaller forms, such as

shrews, mice, weasels, etc. These lesser kinds have thus far apparently been able to maintain themselves in considerable number, in the face of their being crowded into ever narrowing limits.

At the present time there are at least sixty-three species of mammals indigenous to the commonwealth of Pennsylvania. These include one marsupial, the opossum; three moles; five shrews; nine bats; one bear; one raccoon; three weasels; probably two minks, although one is doubtful; one skunk; one otter; two foxes; one wildcat; one deer; and thirty-two rodents. The rodents are the Woodchuck, or Groundhog; two species of Chipmunks; two Red Squirrels; two Fox Squirrels; two Flying Squirrels; two Gray Squirrels; one species of Beaver; four species of Deer-mice; one Cave-rat; one Red-backed Mouse; one Lemming-mouse; one Mole-mouse; one Meadow-mouse; the Muskrat; three species of Jumping Mice; the Black Rat; the Brown (Norway) Rat; the House Mouse; the Porcupine; two species of Rabbits; and one Hare.

The above list includes several exotic species, which have become so general, as to warrant inclusion in the native fauna; while a few introduced species, which are as yet rather limited in numbers and distribution, have been excluded. In the list are several species, which have always been rare, or have not been found in numbers by collectors. Among these are the Marsh-shrew (*Neosorex albibarbis*), a northern species which has been found only in the northeastern part of the state in the Pocono Mountains; the Roof-rat (*Rattus alexandrinus*), an exotic species introduced from Alexandria, Egypt, which probably could not cope with the Norway Rat; and the Woodland Jumping Mouse (*Napæozapus insignis insignis*).

Some mammals, such as Beavers, Fox-squirrels, and Least Weasels, which have been considered more or less uncommon, are increasing in numbers. The Beaver, under rigidly enforced protection, is rapidly recovering its former numbers. There are at least eighteen colonies of beavers within the confines of the state.

On the other hand, the Otter, Mink, and Marten are decreasing in numbers and it is not improbable that the latter has been completely exterminated. The persistence of certain forms is remarkable. The Bob-cat (*Lynx rufus*), which has been persecuted for generations, still abounds; bounties on almost two thousand specimens have been paid in the last five years. The Canadian Bob-cat (*Lynx canadensis*), while never abundant, seems to have completely disappeared from Penn-

sylvania with the Cougar or Mountain-lion. Foxes, with their proverbial cunning, have held their own, although their destruction is encouraged by the State.

Fur-hunters have considerably reduced the numbers of several species, while others are being destroyed for economic reasons, bounties being paid to stimulate their reduction. It is remarkable that the raccoon can persist in face of the demand for "Coon-skin coats."

While the necessity for keeping down the numbers of certain predaceous mammals, which feed upon game-birds and smaller game-mammals, is recognized, the complete extermination of any animal is a risky procedure. As has already been indicated, the removal of any form upsets the balance of nature. Forms, for the protection of which a ruthless war is waged against their enemies, in the absence of the latter frequently multiply so rapidly, that they themselves threaten even greater destruction, and become pests.

While it is true that the weasel is an enemy of quail, pheasants, and rabbits, it should not be forgotten that rats and mice also form a large part of its diet. Its short legs and serpentine body adapt it well to gaining access to the subterranean burrows of rodents, and its complete extermination would undoubtedly remove one of the effective checks against these destructive animals. Hunters do not concern themselves with the eradication of the small rodents, which are well protected by their size, color, and ability to dart into underground shelters. To ignore these and at the same time kill off the predaceous forms, which feed upon them, may prove to be costly.

The recent protests against the killing of does in Pennsylvania were unjustified. It seems always best to accept the judgment of those individuals who constitute the Game Commission, because they are vitally concerned with the problems of conservation and they employ a staff of well trained men, who constantly study the animal problem in all of its aspects. Our limited ranges can support only a proportionate number of deer. Under protection the animals can reproduce with amazing rapidity. When the numbers become too great they are faced with a shortage of food and numbers of them die of starvation in severe winters. In the struggle for existence their feeding becomes so extensive that all the lower sheltering shrubs are devoured. Upon these plants many game birds and smaller mammals depend for shelter. The removal of these "cover" plants is disastrous to the smaller forms, and even to the deer. This has been remarkably

demonstrated in the case of the deer on some of our western forest reservations, who literally ate themselves "out of house and home," and died of starvation.

The distribution of the mammals of Pennsylvania at the present time is to some extent a matter of conjecture, because of the lack of sufficient recent "records." The evidence at hand shows a decided modification of ranges within the past twenty-seven years, since Rhoads conducted his investigations. The establishment of a complete and intricate highway system, which reaches virtually every part of the state, and the introduction of certain species, combined with a gradual crowding of wild creatures into limited areas, have considerably altered the former distribution. Some woodland forms have had their ranges limited by the deforestation of vast areas and many of them are confined to restricted quarters because of wide unforested interspaces, which serve as barriers to migration. The struggle for existence in some of these regions is bitter, while on the other hand, the limitation of areas has caused an emigration of enemies which could not survive in such reduced foraging districts. Consequently the existing species have more favorable auspices for survival and multiplication.

The pollution of streams has contributed greatly to the reduction of aquatic and semi-aquatic mammals. The reduction of feeding grounds always has this effect, and when animals become scarce, there will naturally be a lessening of the numbers which prey upon them.

In considering the matter of geographical distribution within this Commonwealth there are numerous factors to be considered: (1) The adaptability of various mammals for migration; (2) the suitability of habitats; (3) the natural barriers and highways of dissemination and the effects of human activities on these barriers and highways; and (4) climatic zones.

Certain mammals are so well adapted to migration that they inhabit wide ranges and their ability to move from unfavorable situations enable them to survive variable conditions. Naturally the distribution of such species will fluctuate from time to time, but even such mammals as bats, which are admirably adapted to extensive migration, find their activity limited by barriers such as mountains, the crossing of which they may find difficult.

Many mammals are structurally modified for specific habitats.

We have arboreal, terrestrial, aquatic, and aerial forms. These structural adaptations limit some of these kinds to certain districts. Deforestation, agriculture, and drainage naturally in these cases reduce the number of favorable habitats. Forms which are specialized necessarily are restricted to regions where conditions are suitable for their life, and, when these change, they migrate, or perish.

There are three distinct Life-zones in Pennsylvania. These zones cannot be defined in terms of latitude and longitude. The zonation of the fauna of Pennsylvania is largely isothermal, and in consequence is determined along communicating lines, which depend more or less upon temperature fixed by relative elevation.

The Canadian Zone is the most northerly and extends into Warren, Forest, Jefferson, McKean, Elk, Clearfield, Potter, Cameron, Clinton, Tioga, Lycoming, Sullivan, Bradford, Susquehanna, Wyoming, Lackawanna, Wayne, and Pike Counties. It also includes parts of Erie, Clarion, and Indiana Counties and stretches along the Allegheny Mountains into Fayette, Westmoreland, and Somerset Counties. The Northern part of Cambria and some sections of Blair, Bedford, and Center Counties are also included in the Canadian Zone.

Within the Canadian zone are those mammals which are northern in their ranges. The Varying Hare or "Snow-shoe Rabbit" (*Lepus americanus virginianus*), the Marten (*Mustela americana americana*), the Least Weasel (*Mustela allegheniensis*), the Cave-rat (*Neotoma pennsylvanica*), the Woodland Jumping Mouse (*Napæozapus insignis insignis*), the Northern Pine Squirrel (*Sciurus hudsonicus hudsonicus*), the Northern Gray Squirrel (*Sciurus leucotis caroliniensis*), the Beaver (*Castor canadensis*), the Canadian Deer-mouse (*Peromyscus canadensis*), the Red-backed Mouse (*Eutamias gapperi gapperi*), the Meadow Jumping-mouse (*Zapus hudsonicus hudsonicus*), the Porcupine (*Erethizon dorsatum dorsatum*), the Otter (*Lutra canadensis*), the Mink (*Mustela vison vison*), Bonaparte's Weasel (*Mustela cicognanii cicognanii*), the Smoky Shrew (*Sorex fumeus fumeus*), the Marsh Shrew (*Neosorex albibarbis*), the Hairy-tailed Mole (*Parascalops breweri*), the Hoary Bat (*Lasionycteris noctivagans*) are common to the Canadian Zone, and occur in the finger-like extensions of this zone which thrust themselves southward.

The Transition (Hudsonian) Zone in Pennsylvania is very irregular, because of the peculiar topography of the State.

The Austral (Carolinian) Zone is represented by northward pro-

jections dovetailing into the Canadian, which is confined to the higher massifs of the region. Intermediate between the finger-like northward projections of the Carolinian and the southward finger-like projections of the Canadian are intercalated territories of moderate elevation above sea-level, which sometimes are narrow, sometimes broad, representing the Hudsonian, in which there is a commingling of northern and southern forms. As our map shows, the Transition Zone occupies a large part of the northwestern area of the state, the valleys between the great uplifts of the Appalachians and the mountainous parts of the eastern end of the state. In the region of the mountains the Transition Zone is frequently well defined. It includes most of Erie County, Crawford, Mercer, Lawrence, Venango, Butler, Beaver, Armstrong, Clarion, Indiana, and a small part of Allegheny. The Laurel and Chestnut Ridges of the mountains in Fayette and Westmoreland counties are questionable, but undoubtedly lie chiefly in this zone. The sections of Cambria and Somerset between the mountain ridges and also parts of Blair, Bedford, Center, Fulton, Huntingdon, Mifflin, Franklin, Juniata, Snyder, Union, Montour, Northumberland, Columbia, Luzerne, Schuylkill, Lebanon, Lehigh, Monroe, and a part of Berks, where the branches of the Susquehanna River flow from the north, are all within the Transition Zone.

Within the Transition Zone exist the scattered forms of both the Canadian and Carolinian Zones. The more southerly forms not infrequently occur on the lower edge of the Canadian Zone and certain northern species extend, occasionally to the Austral Zone.

The Austral (Carolinian) Zone comprises the southwestern counties of Greene, Washington, Fayette, Westmoreland, Allegheny, Beaver, and the southeastern counties of Lancaster, Chester, Philadelphia, Cumberland, York, Montgomery, Adams, and Bucks. There is an evident, progressive northward migration of both plants and animals in the Susquehanna valley.

The Opossum (*Didelphis virginiana virginiana*), Southern Gray Squirrel (*Sciurus carolinensis*), Rafinesque's Deer-mouse (*Peromyscus leucopus leucopus*) Barton's Jumping-mouse (*Zapus hudsonius americanus*), Lowland Cotton-tail Rabbit (*Sylvilagus floridanus mearnsii*), Mole-shrew (*Cryptotis parva*), Georgia Pygmy Bat (*Pipistrellus subflavus subflavus*), and Rafinesque's Little Brown Bat (*Nycticeius humeralis*), are all characteristic of the Austral (Carolinian) Zone.

The Raccoon (*Procyon lotor lotor*) and the other species mentioned in the recent work of the writer² may be found, generally in the Transition Zone and in the lower Canadian and Upper Austral Zones.

Because of the irregularity of contour of the life-zones we see in Pennsylvania a rather unique distribution of mammals. Where species overlap or graduate into one another (especially in the case of certain mice), the often flimsy bases of subspecification make it difficult to discriminate among them.

Concerning the biology and distribution of Pennsylvanian mammals there is much to be learned. Records from every part of the state are needed and specimens of rats, mice, shrews, bats, flying squirrels, and moles with complete data should be secured from every section. Without these records a thorough knowledge of geographical distribution cannot be ascertained.

The distributional records herein given have been culled from field-notes made by the writer for many years, and from the records of the Pennsylvania State Game Commission, as well as from other sources.

Data concerning the feeding and nesting habits of shrews and information about the migrations of bats, are particularly needed, because of all native mammals these are the least known. However, the present knowledge of our native fauna shows conclusively that Pennsylvania has within its boundaries a remarkable variety of mammalian forms.

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²Williams, Samuel H.—The Mammals of Pennsylvania, U. of P. Press, 1928.

EXPLANATION OF PLATE XIV,
FAUNAL MAP OF PENNSYLVANIA.

The map shows the distribution of life-zones in Pennsylvania. The Pymatuning Swamp in Crawford County constitutes an island of the Canadian Zone, which is gradually becoming smaller through deforesting and draining. The isolation of this area is evidently due to the gradual northward migration of southern forms, which have slowly surrounded the swamp, thus separating it from the rest of the Canadian. This swamp has recently been closely studied by various investigators. (See Sutton, "The Birds of Pymatuning Swamp and Conneaut Lake, Crawford County, Pa." Ann. Carn. Mus., Vol. XVIII, 1928, pp. 19-239).

The valleys of the Susquehanna, Schuylkill, and Delaware rivers are proving to be excellent highways for the northward migration of many plants, and their associated faunæ. Dr. Otto E. Jennings states that the River Birch (*Betula nigra*) and the Persimmon (*Diospyros virginiana*) have ascended the valley of the Juniata and its branches; the mammalian records indicate that these plants have followed the paths of animal forms. The map shows finger-like extensions of the Austral or Carolinian Zone through Juniata, Mifflin, Huntingdon, and even Blair Counties. The branches of the Schuylkill indicate a similar progression.